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THE GEOGRAPHICAL DISTRIBUTION OF BATRACHIA AND REPTILIA IN NORTH AMERICA.

BY E. D. COPE.

As is well known, the aggregates of organic beings called faunæ and floræ correspond in part with the natural land divisions of the earth's surface, but not exactly. The first classification of the primary faunæ was proposed by Dr. P. L. Sclater in 1858, as follows:

1. *Paleartic.*—Europe, Northern Africa, Northern and Central Asia.
2. *Ethiopian.*—Africa south of the Great Desert, and Madagascar.
3. *Indian.*—Southeastern Asia and the Malay Archipelago.
4. *Australian.*—Australia with New Guinea and the adjacent islands, New Zealand and Polynesia.
5. *Nearctic.*—North America as far south as Mexico.
6. *Neotropical.*—Central and South America and the West Indies.

Subsequently Dr. A. R. Wallace proposed that the name Oriental be used in place of Indian.

In 1868 Prof. T. H. Huxley proposed that the world's areas be arranged in two divisions, Arctogæa and Notogæa; the former including the Palearctic, Indian, Ethiopian and Nearctic of Sclater, and the latter including the Australian and Neotropical regions. To the last two he added the Novo Zealanian for New Zealand, and he proposes to change the name of the Neotropical to Austrocolumbian.

In 1871 Dr. J. A. Allen proposed the following faunal divisions: I. Arctic Realm; II. North Temperate Realm; III. American Tropical Realm; IV. Indo-African Tropical Realm; V. South American Temperate Realm; VI. African Temperate Realm; VII. Antarctic Realm; VIII. Australian Realm.

In 1874 Sclater modified his system as follows: He retained the term Arctogea in the Huxleyan sense. To the Neotropical region he gave the name of Dendtrogea, and to the Australian he gave the name Antarctogea, omitting New Zealand and Polynesia, which he constituted a fourth division, Ornithogea.

In 1878 Heilprin proposed the name Holarctic, to include Sclater's Palearctic and Nearctic regions. He also proposed two transitional regions; that of the Old World he called Mediterranean and that of the New World the Sonoran, the latter a term already introduced by Cope for a division of the Nearctic of Sclater.

In 1884 Gill proposed the following primary divisions or realms: 1. Anglogæan (N. American); 2. Eurygæan, or Eurasian; 3. Indogæan; 4. Afrogæan; 5. Dendrogæan, or Tropical American; 6. Amphigæan, or Temperate South American; 7. Austrogæan, or Australian; 8. Ornithogæan, or New Zealand; 10. Nesogæan, or Polynesian. Prof. Gill justly insisted on the importance of fresh water fishes as furnishing definitions of natural faunal realms and regions.

In 1890 Blanford published a system of geographic zoology in which he adopted the primary divisions of Huxley, and divided the Arctogaean region into the following: Malagasy, Ethiopian, Oriental, Aqulonian (= Palearctic and northern part of Nearctic), and Medio-Columbian (S. part of Nearctic).

In 1896 Lydekker proposed the following divisions: I. Notogæic Realm; regions: 1. Australian; 2. Polynesian; 3. Hawaiian; 4. Austromalayan. II. Neogæic Realm; regions: Neotropical. III. Arctogæic Realm; regions: 1. Malagasy; 2. Ethiopian; 3. Oriental; 4. Holarctic; 5. Sonoran. Lydekker makes use of paleontologic evidence in this connection. While this treatment of the subject is important from the point of view of origin, it is often irrelevant, since the distribution of vertebrate life in each geologic age was different from that in each other geologic age.

In an essay on the geographical distribution of North American Reptilia published in 1875, the present writer adopted the first system of Sclater. After a lapse of twenty years, the light thrown on the subject by various investigators suggests the following modifications. In the first place the recognition of the close similarity of the life of the northern regions of the earth, requires more definite formulation than was accorded it in

Sclater's first system, by the union of his three divisions of Nearctic, Palearctic and Indian into one, for which the name Arctogæa is appropriate. The enclosure of his Ethiopian division in it as proposed by Huxley, does not seem to me to be proper, in view of the important types of fishes and reptiles which characterize it; *e. g.*, the Crossopterygian, Dipnoan and Scyphophorous fishes, and the Pleurodire tortoises. In the fishes, indeed, the Ethiopian region has as much affinity with the Neotropical fauna as with any other, in its Characin and and Cichlid families, and in the Dipnoan subclass. The presence of the Dipnoi and the Pleurodire tortoises ally it to the Australian fauna as well. It is for these reasons that Prof. Gill proposes to combine the southern hemisphere realms into a single "Eogaean" division. The northern affinities of the Ethiopian realm are, however, too many to permit us to regard this arrangement as a just expression of the facts. Thus, it has Insectivorous Mammalia, Firmisternial Batrachia Anura, and Cyprinid fishes, none of which are Australian or Neotropical types. The course that remains under the circumstances is to regard the Ethiopian Realm as fully distinct from the other three. The definitions of the four primary divisions are then as follows:

The *Australian realm* is peculiar in the absence of nearly all types of Mammalia, except the *Ornithodelphia* and the Marsupials; in the presence of various Ratite birds, in great development of the Proteroglyph serpents, and absence of the higher division of both snakes and frogs; *i. e.*, *Solenoglypha* and *Firmisternia;* in the existence of *Dipnoi* (*Ceratodus*) and certain Isospondylous families of fishes. On the other hand many of the lizards and birds are of the higher types that prevail in India and Africa, viz.: the *Agamidæ* and the *Oscines*.

The *Neotropical realm* only possesses exclusively the Platyrhine monkeys and the great majority of the humming birds. It shares with the other Southern regions the Edentate and Tapiroid mammals; Ratite, Pullastrine, and Clamatorial birds; Proteroglyph snakes; Iguanid Lacertilia, the Agamids being entirely absent; Arciferous frogs; and Characin, Chromid, Osteoglossid, and Dipnoan fishes. It has but few types of the

Northern regions; these are a few bears, deer, and oscine birds. Insectivorous mammalia, Viperid serpents, and Ginglymodous, Halecomorphous and Cyprinid fishes are wanting, except on the northern border.

The *Ethiopean realm* is that one which combines the prevalent features of the Arctogean realm with the southern hemisphere types already mentioned, together with some found elsewhere only in the Indian region, and a very few peculiar. The two latter classes not being mentioned elsewhere, they may be here enumerated. The region shares, with the Indian alone, the Catarrhine monkeys, the *Elephantidæ, Rhinocerotidæ,* Nomarthrous Edentata and Chameleons. Its peculiar types are the *Lemuridæ, Hippopotamidæ* and *Protelidæ, Cryptoproctidæ* and *Hyracoidea* among mammals, and *Polypteridæ* and *Mormyridæ* among fishes. It possesses in common with the Neotropical realm characinid, cychlidi, and dipnoan fishes, Pleurodire tortoises and Ratite and Trogonoid birds; and differs from it in the absence of arciferous Batrachia and crotalid snakes, and presence of dendraspid, causid, atractaspid and viperid snakes.

The *Arctogean Realm* is characterized by the absence of types conspicuous elsewhere, and by the presence of a few peculiar forms. Among fishes it lacks Dipnoi and Crossopterygia, Osteoglossidæ, Characinidæ and Cichlidæ. It lacks Pleurodire tortoises and Ratite birds. Ginglymodous fishes and Urodele Batrachia are nearly confined to it, merely extending a little over the border of the Neotropical. Its Cryptodire tortoises extend both into the Neotropical and Ethiopian. Anguid lizards are confined to it. It shares most of its Mammalia with other regions. The Insectivora it shares with the Ethiopian, and its deer and camels with the Neotropical. The genus Ursus is very characteristic, one aberrant species only extending into the Neotropical.

From what has preceded it is seen that the primary differences between the faunæ of the realms are to be found to a large degree in the lower vertebrata, the fishes, Batrachia and Reptilia. These forms furnish stronger distinctions than the birds and mammals, owing to their greater inability to traverse natural boundaries. Neglect of these indications has led to much of the difference of opinion in the question of geographical distribution, which have been founded principally on the conditions presented by the birds and mammalia.

In this system fragments of existing or old continents, which have been subjected to conditions unfavorable to particular forms of life otherwise prevalent in them, are, as in the system of Sclater, disregarded. Thus, islands generally are not regarded as presenting conditions definitive of divisions of the first rank, as was done by Huxley and Gill in the case of New Zealand, and Gill and Lydekker in the Polynesian Islands. The temperate regions of Africa and South America are certainly not separable from the tropical portions, as divisions of primary rank, as was done by Allen, who is followed as to South America by Gill. With equal propriety western North America might be separated from Mississippi and Atlantic North America, on account of the great deficiency of its fish fauna. In estimating faunistic affinities one has to give similarities over a given area more weight than differences, where the differences are only due to absence of types.

Finally, it must be remembered that there are geographic points of transition between all the realms.

I. THE ARCTOGEAN REALM.

This realm includes three regions, viz.: the Indian, the Holarctic and the Medicolumbian. I have already defined the first two in general terms. The third is the transitional of Heilprin, the Sonoran of Merriam and Lydekker, and the Neotemperate of Townsend. It embraces what is left of the Nearctic of Sclater after the subtraction of the Holarctic. As the name Sonoran has been previously given by me to one of the districts of this region, I have preferred to use for it the name given by Blanford.

The faunal characteristics of these regions may be enumerated af follows:

Indian Region.—Presence of Holostomatous fishes. Absence of Ginglymodous and Halecomorphous and Salmonid fishes. Presence of Cœciliid Batrachia. Absence of Trachystomatous, Amphiumid, Cyptobranchid, and Arciferous Batrachia. Presence of Agamid lizards, and Anigiostomatous and Viperid snakes. Presence of Phasianid, Eurylæmid, Nectariniid and Pittid birds. Absence of Tyrannid and of several nine-quilled oscine families. Presence of nomarthrous Edentata, of Viverridæ, Hyænidæ, Tupæidæ and Tarsiidæ. Presence of Rhinocerotidæ, Tapiridæ, Proboscidia, and Catarrhine Quadumana, and Anthopomorpha. Absence of Didelphyidæ, Procyonidæ and Scalopidæ.

Holarctic Region.—Absence of Holostomatous and Halecomorphous fishes. Presence of Ginglymodous and Salmonid fishes. Absence of Trachystomatous, Amphiumid and Cœciliid Batrachia, and absence of the Arcifera except the family Discoglossidæ (two species of Hyla excepted). Absence of Angiostomatous and presence of Viperid snakes. Presence of Phasianid, and absence of Eurylæmid, Nectariniid, Pittid and Tyrannid birds, and of several nine-quilled oscine families or subfamilies. Absence of Nomarthrous Edentata, of Viverridæ, Hyænidæ, Tupæidæ, Rhinocerotidæ, Tapiridæ, Proboscidia, Quadrumana and Anthropomorpha (except Homo).

Medicolumbian Region.—Absence of Holostomatous fishes; presence of Ginglymodous and Halecomorphous fishes. Presence of Trachystomatous, Amphiumid, Aciferous and Firmisternial Batrachia, and absence of Cœciliidæ. Presence of Iguanid, and absence of Agamid and Chamæleonid lizards; absence (except three species) of Angiostomatous and of Viperid snakes. Absence of the Indian types of Passeres mentioned, and presence of Tyrannid Clamatores, and several groups of nine-quilled Oscines (Icteridæ Mniotiltidæ, Tanagridæ). Absence of all the specially Indian mammalia, and of the Holarctic Erinaceidæ, and presence of Didelphyidæ (one species), Scalopidæ and Procyonidæ.

In defining these regions I have restricted myself necessarily to types of tolerably high rank, and have not referred to species. This is because species are not generally characteristic of entire divisions, but only of parts of them. One cannot, however, be absolutely exact in such major definitions, since a number of the conspicuous types in each are not universally distributed over these areas.

In comparing the Holarctic with other realms, I have already referred to the number of types which it possesses in common with the Ethiopian, not found in the Neotropical. It has also several in common with the Neotropical, which do not occur in the Ethiopian. These are the Arciferous Batrachia, the Crotalid snakes, and the deer (Cervidæ). The Medicolumbian division of the Holarctic shares other forms with the Neotropical. These are Didelphyidæ and Procyonidæ among Mammalia; Tyrannid, Icterid and Tanagrid birds; Kinosternid tortoises and the Arciferous Batrachian family Hylidæ.

Some of the forms of the Holarctic region are not uniformly distributed over it. Thus the Ginglymodous and Spatulariid fishes only occur in the eastern parts of the eastern and western continents. The same is true of the Silurid genus Amiurus and the Loricate genus Alligator. The Crotalid snakes are not found in the western parts of Eurasia. The Batrachian Cryptobranchidæ have the same distribution.

II. THE MEDICOLUMBIAN REGION.

This region was formerly included in the Nearctic of Sclater, and the area thus constituted has the following geographic boundaries. To the south it includes the plateau of Mexico, including the central valley. The Neotropical area bounds it to the east and west, occupying the low-lands or Tierra Caliente to a point 150 miles south of the Rio Grande on the east, (Townsend, Texas Academy of Science, 1895, p. 87), and to Mazatlan, or some point not far from it, on the west. The high land of Oaxaca is its extreme southern outpost. Its northern boundary is thus described by Merriam.[1] The "Boreal" (Holarctic realm) "Province extends obliquely across the entire continent from New England and Newfoundland to Alaska, conforming in direction to the trend of the northern shores of the continent. It gives off three long arms or chains of islands which reach far south along the three great mountain systems of the United States, a western arm in the Cascades and Sierra Nevada, a central arm in the Rocky Mountains, and an eastern arm in the Alleghanies, and these interdigitate with northward prolongations of the Sonoran" (Medicolumbian) "province, which latter completely surrounds the southern islands of the Boreal" (Holarctic) "system."

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[1] Biological survey of the San Francisco Mountain; N. Amer. Fauna, No. 3, 1890, p. 24.

The faunal relations of the Medicolumbian realm may be tabulated as follows:

Agrees with Holarctic in	Differs from Paleartic in	
	Peculiar Forms	Neotropical Forms
Mammalia in general		Bassaridæ.
Except		Procyonidæ.
	Antilocapra	Megadermatidæ.
	Mephitis	Dicotyles.
	Scalopidæ	Didelphys.
Birds, except		Cathartidæ.
		Tanagridæ.
		Icteridæ.
		Clamatores in general.
		Trochilidæ.
	Meleagridæ	Odontophorinæ.
		Alligators.
		Tiid and Gerrhonotid lizards.
		Iguanid lizards.
Emyd tortoises	Chelydridæ	Cinosternidæ.
Lachesinæ	Crotalinæ	Elapid venomous snakes.
Raniform frogs		Arcifera.
Scaphiopidæ	Plethodontidæ	Engystomidæ.
	Amblystomidæ.	
	Desmognathidæ.	
Diemyctylus		
Cryptobranchidæ		
	Trachystomata.	
	Necturus.	
	Amphiumidæ.	
Percid fishes	Aphredoderidæ	
Cottidæ	Percopsidæ.	
Haplomi	Amblyopsidæ.	
Accipenseridæ.		
Spatulariidæ.		
Cyprindæ	Plagopterinæ.	
	Catostomidæ.	
Gasterosteidæ.		
Salmonidæ.		
	Amiidæ.	
	Lepidosteidæ.	
Petromyzon		

Baird[2] divided this region into three districts, which he termed the eastern, central and western. The eastern occupied eastern North America to the central plains, where they exceed 800 feet above sea-level. The western included the territory between the Cascade and Sierra Nevada Mountains and the Pacific Ocean. In my paper of 1875,[3] I adopted the eastern, central and western districts (calling the last the Pacific), and proposed two other districts, viz.: the Austroriparian for the Louisianian division of the eastern of Verrill, and the Sonoran for the southwestern and Mexican Plateau faunæ. Merriam, in 1890,[4] proposed a different arrangement. Using the name Sonoran for the entire Medicolumbian Region he divided it into "(1) an *Arid* or Sonoran subregion proper, occupying the table-land of Mexico, reaching north into western Texas, New Mexico, Arizona, and southern California; (2) a *Californian* subregion, occupying the greater part of the State of that name; (3) a *Lower Californian subregion;* (4) a *Great Basin* region, occupying the area between the Rocky Mountains and the Sierra Nevada, extending as far north as the plains of the Columbia; (5) a *Great Plains* subregion, occupying the plains east of the Rocky Mountains, and extending north to the plains of the Saskatchewan; and (6) a *Louisianian* or *Austroriparian* subregion, occupying the low-lands bordering the Gulf of Mexico and the Mississippi, and extending eastward south of the Alleghanies to the Atlantic seaboard, where it reaches as far north as the mouth of Chesapeake Bay." According to his arrangement the Eastern Region of Baird and myself is not mentioned.

This classification may be applicable to birds and mammals; but it is not applicable to the fishes, Batrachia and Reptilia, which are much more exact indicators of the histories of faunæ, owing to their inferior powers of migration. The eastern district or subregion is more nearly allied, from this point of view, to the Austroriparian than the latter is to the Sonoran proper, or arid region. This is due, as Baird previously pointed out, to the great difference in rainfall between the part of the continent lying eastward of the 100th meridian and that part which lies west of it. This difference is coincident with a profound difference in geologic age between the regions west of that meridian and the eastern district, the former having a short continental history as compared with the latter.

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[2] Amer. Jour. Sci. Arts, XCI, 1866, p. 82.

[3] Bulletin U. S. Natl. Museum, I, 1875, p. 55.

[4] N. American Fauna, 1890, No. 3, p. 24.

I, however, agree with Merriam in the abolition of the "Central" as a subregion of Medicolumbia.

The relation of the several zoological divisions to these subregions are as follows: The eastern subregion is the original centre of distribution of all the fishes peculiar to the Medicolumbian region, except only the Plagopterine Cyprinidæ. It is the centre of distribution of all the Batrachia, with the following exceptions: The degenerate types of Trachystomata and Amphiumoidea probably originated in the Austroriparian subregion, and the species of Bufo in the Sonoran. The eastern subregion is also the source of the aquatic Testudinata. On the other hand the Sauria of the eastern and Austroriparian subregions are an overflow from the abundant lizard life of the Sonoran region, excepting the family of the skincs, and the genus Anolis, the latter being of Neotropical origin. The snakes also are mainly Sonoran types, including especially the true rattlesnakes. The copperheads and ground rattlesnakes are on the contrary indigenous to the eastern subregion. The Pacific subregion has close affinities with the Sonoran, but of a largely different kind as to its lizards, while the Batrachia have the character of the eastern types as far as they go.

The distribution of types indicates six principal subdivisions, which I call the Floridan, Austroriparian, Eastern, Sonoran, Western, and Toltecan subregions. The Floridan subregion includes the greater part of the peninsula of Florida, being bounded approximately on the west by the Suwanee River. The Austroriparian subregion extends northward from the Gulf of Mexico to the isothermal of 77° F. It commences near Norfolk, Va., and occupies a belt along the coast, extending inland in North Carolina. It passes south of the Georgia Mountains, and to the northwestward up the Mississippi Valley to the southeastern part of Illinois. West of the Mississippi the boundary crosses Missouri, extends south along the southern boundary of high lands of Texas, and reaches the Gulf at the mouth of the Rio Grande. The Eastern subdivision is the most extended, reaching from the isothermal line of 77° F. north and from the Atlantic Ocean to the elevated plains west of the Mississippi River. Many of its forms extend up the bottoms of the rivers which flow to the eastward through the plains. The Sonoran subregion extends from the limit of the Eastern as far west as the Sierra Nevada, and south, including Nevada, New Mexico, Arizona, Sonora and the Plateau of Mexico, including the State of Chihuahua, and, perhaps, Durango. It does not cross the Sierra Nevada, but includes the entire peninsula of Lower California. It extends northward on the east side of the Sierra Nevada as far as, including the arid region of British Columbia. It occupies the valley of the Rio Grande, and extends into Texas as far as the Rio Pecos. It extends southward in western Mexico as far as Mazatlan. The Western subdivision extends from the Pacific coast to the Sierra Nevada to an uncertain distance on the Lower Californian Peninsula. At the north it crosses the Sierra Nevada, skips the narrow strip of the Sonoran in Washington, and extends to the Rocky Mountains, including northern Idaho and western Montana. The Toltecan subregion includes the States of Guanajuato, Mexico, and the adjacent elevated regions of Michoacan, Oaxaca and Puebla, including the Alpine regions of the southern Sierra Madre. It is probable that another subregion should be added, the Tamaulipan of Townsend. This is a dry region extending from near the mouth of the Rio Grande to the Rio Soto la Marina in the State of Tamaulipas. More information regarding the fauna of this country is desirable.

The faunal peculiarities of these subregions are well marked. The three subregions included in eastern North America differ from all the others in the abundance of their turtles and the small number of their lizards. Prolific of life, this area is not subdivided by any marked natural barriers. Hence, though its species present great varieties in extent of range, it is not divided into districts which are very sharply defined. The warmer regions are much richer in birds, reptiles and insects than the cooler; and as we advance northward many species disappear, while a few others are added. The natural division of the eastern part of the continent is then in a measure dependent on the isothermal lines which traverse it, which accord also quite closely with its geologic history.

The *Floridan subregion* is distinguished by the presence of several peculiar genera of Batrachia and Reptilia, and by a number of peculiar species. A special feature is the almost total absence of Batrachia Urodela. The genera are:

BATRACHIA:
  Lithodytes,
  Pseudobranchus.

SERPENTES:
  Stilosoma,
  Rhadinæa,
  Seminatrix,
  Liodytes.

SAURIA:
  Rhineüra,
  Sphærodactylus.

Lithodytes and Sphærodactylus are West Indian Neotropical genera, and Rhadinæa, besides being Neotropical, extends into the eastern part of the Austroriparian subregion. Five genera are then peculiar. The peculiar species will be enumerated later. Several species of mammals are confined to this region. The genera of birds that do not range north of it are, according to Allen:

Certhiola	
Zenæda	Pigeons.
Oreopelia	
Starnænas	
Rostrhamus	Raptores.
Polyborus	
Aramus	Waders.
Audubonia	
Phœnicopterus.	
Haliplana	Terns.
Anous	

The isolation of the Floridan subregion is due to the fact that the nucleus of the peninsula (which is of Eocene age) was separated from the continent during the greater part of neocene time. If at at any time connected with the Antilles, the period was of short duration.

The *Austroriparian region* possesses many peculiar genera of reptiles not found elsewhere, while the region north of it possesses none, its genera being distributed over some or all of the remaining regions. The number of peculiar species in all departments of animal life is large. It presents the greatest development of the eastern reptile life. Sixteen genera of Reptiles and eight of Batrachia do not range to the northward, while ninety-nine species are restricted in the same manner. The peculiar genera which occur over most of its area are:

SAURIA:
- *Anolis.*

SERPENTES:
- *Elaps,*
- *Haldea,*
- *Cemophora,*
- *Tantilla,*
- *Compsosoma,*
- *Farancia.*

TESTUDINATA:
- *Macrochelys.*

LORICATA:
- *Alligator.*

BATRACHIA:
- *Engystoma,*
- *Manculus,*
- *Amphiuma,*
- *Siren.*

I have omitted from this list ten genera which are restricted to one or the other of its subdivisions. The *Siren*, the *Cemophora*, the *Anolis*, and the *Alligator*, are the most striking of the above characteristic genera. No genus of lizards is peculiar excepting *Anolis*, which has its greatest development in other than the Nearctic continent. Among Serpents a few genera of Neotropical character extend eastward along the region of the Mexican Gulf, as far as the Atlantic coast, which are not found in any of the northern regions; such are *Compsosoma*, (Central American); *Tantilla*, and *Elaps* (Sonoran). On the other hand, *Abastor*, *Virginia*, *Haldea*, and *Storeria*, embrace serpents which it shares with the Eastern region.

This region is the headquarters of the Batrachia, especially of the tailed forms. The majority of species of the tailless genera are found here, especially of *Hyla* (tree-toads), *Rana*, and *Chorophilus*.

There are no less than nine genera of birds which do not, or only accidentally, range northward of this district. They are, according to Allen:

Plotus,
Tantalus,
Platalea,
Elanus,
Ictinia,

Conurus,
Chamæpelia,
Campephilus,
Helinæa.

All these genera, excepting the last, range into South America or further.

Among mammals, but few species and one genus (*Sigmodon*) are confined to it. *Lepus aquaticus* and *L. palustris*, the cotton rat, etc., and a few others, are restricted by it. The fish fauna is very similar to that of the Eastern region.

The *Eastern subregion* differs from the Austroriparian almost entirely in what it lacks, and agrees with it in all those peculiarities by which it is so widely separated from the subregion. No genus of mammals is found in it which does not range into other regions, excepting *Condylura* (star-nosed mole); but numerous species are confined to it, not extending into the Austroriparian. These number from twenty to twenty-five. Among birds, the following genera are, according to J. A. Allen, shared with the more southern region only: *Quiscalus, Siurus, Helmitherus, Protonotaria, Parula, Mniotilta.* No genus of Reptiles, and but one of Batrachians (*Gyrinophilus*), is confined to this region; but it shares all it possesses with the Austroriparian. It has but four genera of lizards, viz.: *Sceloporus, Cnemidophorus Liolepisma* and *Eumeces.*

The *Sonoran subregion* is characterized in the lower vertebrate fauna, by great poverty in fishes, batrachians and tortoises, and abundance of lizards and snakes. Among fishes it lacks the orders Ginglymodi, Halecomorphi and Chondrostei, and possesses only one peculiar group, the Plagopterinæ, a division of the Cyprinidæ. Of usual Holarctic types it possesses only Isospondyli (Salmonidæ) and Plectospondyli; Percomorphi and Nematognathi being absent. The rivers that intersect its central district contain these types, but they must be reckoned as belonging with their bottom lands to the Eastern subregion; the high plains only belonging to Sonoran. The true drainage area of the Sonoran subregion is that of the Colorado.

No genus of Batrachia is peculiar to it, and the following divisions are wanting: Proteida, Trachystomata, Amphiumoida, and all Pseudosauria, except Amblystomidæ (one species). The genus Bufo is the only one that is well represented.

The following genera of reptiles are peculiar to it:

Uta,
Uma,
Sauromalus,
Callisaurus,
Dipsosaurus,
Anota,
Lichanura,
Phyllorhynchus,
Chionactis,
Chilomeniscus.

It shares the following genera with the Central American subregion of the Neotropical Realm only:

Ctenosaura.
Eublepharis (also in the Indian region).
Phyllodactylus (also in the Columbian Neotropical).
Heloderma.
Hypsiglena.
Salvadora.
Rhinechis (also Holarctic of Eurasia).
Trimorphodon.
Tantilla (also in Brazilian Neotropical).
Cinosternum (also in Brazilian Neotropical).

The following genera of the Sonoran subregion enter the Texan district of the Austroriparian subregion:

Holbrookia,
Crotaphytus,
Phrynosoma,
Gerrhonotus,
Hypsiglena,
Rhinochilus,
Cinosternum.

Many species are peculiar to this subregion, as will be shown later on.

The *Western subregion* is distinguished by the absence of most of the types of fishes of the humid part of the continent, and the presence of a few. Thus, the Ginglymodi, Halecomorphi and Catostomidæ are absent, while Percomorphi are present. The Batrachian fauna lacks the Proteida, Trachystomata and Amphiumoidea, while Pseudosauria are abundant, excepting Cryptobranchidæ. All the families of Salientia characteristic of Medicolumbia are present except the Engystomidæ. Among reptiles the genus Charina is entirely characteristic, and Gerrhonotus of the Toltecan and Sonoran faunæ ranges its entire length. It is especially distinguished by the absence of the following genera: First, all of the Iguanidæ exclusively characteristic of the Sonoran fauna, there remaining only *Crotaphytus*, *Sceloporus*, and *Phrynosoma*, which also enter the Texan district of the Austroriparian; by the absence of *Heloderma*, *Ophisaurus* and *Liolepisma*. Among snakes, by the absence of true water snakes (genus Natrix), and the small burrowing Natricinæ, of Opisthoglyph forms, and of poisonous snakes of the genera *Elaps* and *Systrurus*. No genus but *Charina* can be cited as of universal distribution, which is not at the same time found in some other subregion; but several genera occur in one or the other of its districts which do not occur elsewhere. Similarly no genus of birds or mammals can be exclusively assigned to its entire area; but *Chamæa* of the former class and *Haplodontia* of the latter are restricted to particular portions of it.

The *Toltecan subregion* is characterized by the genera it lacks as well as those which it possesses. Thus, it lacks all the genera of Sauria above cited as characteristic of the Sonoran subregion, including those enumerated as passing over into the Austroriparian ecept *Phrynosoma*. It also lacks the following genera of snakes which are found in the Sonoran:

Lichanura,
Pityophis,
Ophibolus,
Chilomeniscus,
Zamenis,
Phyllorhynchus.

From the Austroriparian subregion it differs in the lack of all the numerous genera of Fishes and Batrachia Urodela, which characterize it, excepting only *Spelerpes*. It lacks also the following genera of snakes: *Cyclophis*, *Virginia*, *Haldea* and *Carphophiops*; and *Natrix* is very sparsely if at all represented.

In its positive characters the Toltecan subregion combines certain forms of both the Sonoran and Austroriparian subregions. Of the former character are *Spea, Phrynosoma, Barissia, Gerrhonatus, Hypsiglena* and *Salvadora;* of the latter kind, *Spelerpes, Liolepisma, Osceola, Storeria* and *Systrurus.* Characteristic of Medicolumbia generaly: *Amblystoma, Rana, Sceloporus, Eumeces, Diadophis, Eutænia, Crotalus.* Peculiar genera:

Siredon,	*Hemigenius,*
Thorius,	*Epiglottophis,*
Malachylodes,	*Ogmius,*
Conopsis,	*Ophryacus.*

Neotropical genera: *Oedipus, Anolis, Celestus, Atractus, Ninia, Drymobius, Bothriechis.*

(*To be continued.*)

FOSSILS AND FOSSILIZATION.

By L. P. Gratacap.

I.

A fossil, in Paleontology, is any indication of life which has become entirely or partially altered in its substance or condition by the mineral or chemical agencies of its environment. As an " indication " it embraces the widest possible series of remains which have, or could have, any connection with living organisms, from the bones of a vertebrate, the hard parts of an invertebrate, the foliage, fronds, seeds and wood of plants, to the fillings of worm burrows, the tracks of insects, reptiles, mammals, mollusca and crustaceans, and those problematic impressions which have been referred to Medusa, or those by Prof. Hall to the soft parts of an Orthoceras. And it also includes the stony casts formed by the entrance of extraneous mud or silt, sand or chemical deposits within the hard parts of animals upon their death and the disappearance of the soft parts by decay. The hard parts, upon removal by solution, leave the impressions of their interior upon this soft filling which faithfully copies the contour and size of the organism.